

<b>Title:</b> Converting between numbers expressed in scientific notation and in standard form		
<b>Grade:</b> HS		
<b>PA Core Standard:</b> CC.2.1.HS.F.1 Apply and extend the properties of exponents to solve problems with rational exponents		
<b>PA Connector:</b>		Convert between numbers expressed in scientific notation and in standard form
<b>Strand:</b> Numbers and Operations		<b>Family:</b> Understanding base Ten Number System
<b>Progress Indicator:</b> H.NO.1a using exponents and scientific notation to represent quantities and expressions		
<b>Big Idea(s):</b> Measurement attributes can be quantified and estimated using customary and non-customary units of measure.		
<b>Essential Question(s):</b> Why does “what” we measure influence “how” we measure?		
<b>Foundational Knowledge:</b> <ul style="list-style-type: none"> <li>Understand that (<math>a &gt; 0</math>) <math>10^a</math> indicates that we multiply by 10 <math>a</math> times (e.g. <math>1.04 \times 10^6</math> we would multiply 1.04 by 10 six times or <math>1.04 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10</math>)</li> <li>Understand that (<math>a &lt; 0</math>) <math>10^a</math> indicates that we divide by 10 <math> a </math> times (e.g. <math>2.191 \times 10^{-3}</math> we would divide 2.191 by 10 three times or <math>2.191 \div 10 \div 10 \div 10</math>)</li> <li>Match equivalent numbers in scientific and standard notation.</li> </ul>		
<b>Key Vocabulary, Concepts and Symbols:</b> <ul style="list-style-type: none"> <li>Understand the concepts, symbols, and vocabulary: Scientific notation, base number, exponent</li> </ul>		
<b>Suggested Instructional Strategies:</b> <ul style="list-style-type: none"> <li>Task analysis (for Scientific to Standard Form) <ul style="list-style-type: none"> <li>Identify the exponent.</li> <li>Identify whether the exponent is positive or negative.</li> <li>Determine how many times to multiply/divide by 10.</li> <li>Multiply/divide the coefficient.</li> <li>Assess the reasonableness of the answer</li> </ul> </li> <li>Task analysis (for Scientific to Standard Form for numbers <math>\geq 10</math>) (e.g. <b>12345.6</b>) <ul style="list-style-type: none"> <li>Move the decimal from the current place to the left until the number is <math>&lt; 10</math>. (e.g. <b>1.23456</b>)</li> <li>Count the number of moves the decimal made in step 1. (e.g. <b>4 moves</b>)</li> <li>Write your new number from step 1 “times 10” with an exponent equal to the number of places the decimal moved in step 2. (e.g. <b><math>1.23456 \times 10^4</math></b>)</li> </ul> </li> <li>Task analysis (for Scientific to Standard Form for numbers <math>&lt; 1</math>) (e.g. <b>0.0789</b>) <ul style="list-style-type: none"> <li>Move the decimal from the current place to the right until the number is <math>&gt; 0</math> but <math>&lt; 10</math>. (e.g. <b>7.89</b>)</li> <li>Count the number of moves the decimal made in step 1. (e.g. <b>2 moves</b>)</li> <li>Write your new number from step 1 “times 10” with an exponent equal to the opposite (negative) of the number of places the decimal moved in step 2. (e.g. <b><math>7.89 \times 10^{-2}</math></b>)</li> </ul> </li> <li>Model, lead, test through the steps of the task analysis</li> </ul>		

**Supports and Scaffolds Considerations:**

- Foam numbers that allow the student to physically move the decimal.
- Graphic organizer that help model the movement of the decimal when multiplying or dividing by 10.
- Assistive Technology (e.g., interactive whiteboard or other software, calculator , communication device)

**Key Word Search:** scientific notation, standard form

DRAFT

<b>Title:</b> Explaining the influence of an exponent on the location of a decimal point given in scientific notation		
<b>Grade:</b> HS		
<b>PA Core Standard:</b> CC.2.1.HS.F.1 Apply and extend the properties of exponents to solve problems with rational exponents		
<b>PA Connector:</b>		Explain the influence of an exponent on the location of a decimal point given in scientific notation
<b>Strand:</b> Numbers and Operations		<b>Family:</b> Understanding base Ten Number System
<b>Progress Indicator:</b> H.NO.1a using exponents and scientific notation to represent quantities and expressions		
<b>Big Idea(s):</b> Mathematical relationships among numbers can be represented, compared, and communicated.		
<b>Essential Question(s):</b> How is mathematics used to quantify, compare, represent, and model numbers?		
<b>Foundational Knowledge:</b> <ul style="list-style-type: none"> <li>Understand that (<math>a &gt; 0</math>) <math>10^a</math> indicates that we multiply by 10 <math>a</math> times (e.g. <math>1.04 \times 10^6</math> we would multiply 1.04 by 10 six times or <math>1.04 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10</math>)</li> <li>Understand that (<math>a &lt; 0</math>) <math>10^a</math> indicates that we divide by 10 <math> a </math> times (e.g. <math>2.191 \times 10^{-3}</math> we would divide 2.191 by 10 three times or <math>2.191 \div 10 \div 10 \div 10</math>)</li> <li>Understand that the exponent number equals the number of places to the right of left of the decimal. See chart below.</li> </ul>		
<b>Key Vocabulary, Concepts and Symbols:</b> <ul style="list-style-type: none"> <li>Understand the concepts, symbols, and vocabulary: Scientific notation, base number, exponent</li> </ul>		
<b>Suggested Instructional Strategies:</b> <ul style="list-style-type: none"> <li>Explicit instruction on the patterns of 10 raised to a power (e.g., the exponent will indicate how many places the decimal moves to the left or the right) <ul style="list-style-type: none"> <li>Model, lead, test*</li> </ul> </li> </ul>		

**Supports and Scaffolds Considerations:**

- Graphic organizer
- Reference table (see below)

Common name	Decimal form	Power of 10	Scientific Notation
<i>One millionth</i>	0.000001	$10^{-6}$	$1 \times 10^{-6}$
<i>One thousandth</i>	0.001	$10^{-3}$	$1 \times 10^{-3}$
<i>One hundredth</i>	0.01	$10^{-2}$	$1 \times 10^{-2}$
<i>One tenth</i>	0.1	$10^{-1}$	$1 \times 10^{-1}$
<i>One</i>	1	$10^0$	$1 \times 10^0$
<i>Ten</i>	10	$10^1$	$1 \times 10^1$
<i>One hundred</i>	100	$10^2$	$1 \times 10^2$
<i>One thousand</i>	1,000	$10^3$	$1 \times 10^3$
<i>One million</i>	1,000,000	$10^6$	$1 \times 10^6$
<i>One billion</i>	1,000,000,000	$10^9$	$1 \times 10^9$
<i>One trillion</i>	1,000,000,000,000	$10^{12}$	$1 \times 10^{12}$

- Refer to Instructional Resource Guide for full descriptions and examples of systematic instructional strategies.
- Assistive Technology (e.g., interactive whiteboard or other software, calculator , communication device)

**Key Word Search:** scientific notation, standard form

<b>Title:</b> Using structure, simplify expressions that include exponents		
<b>Grade:</b> HS		
<b>PA Core Standard:</b> CC.2.1.HS.F.1 <b>Apply and extend the properties of exponents to solve problems with rational exponents</b>		
<b>PA Connector:</b>		Using structure, simplify expressions that include exponents
<b>Strand: Numbers and Operations</b>		<b>Family:</b> Perform Operations with Whole Numbers
<b>Progress Indicator:</b> <i>H.NO.1a using exponents and scientific notation to represent quantities and expressions</i>		
<b>Big Idea(s):</b> Patterns exhibit relationships that can be extended, described, and generalized.		
<b>Essential Question(s):</b> How can patterns be used to describe relationships in mathematical situations?		
<b>Foundational Knowledge:</b> <ul style="list-style-type: none"><li>Identify the exponent and the base in numbers and expressions</li><li>Understand exponents as repeated multiplication</li><li>Write expressions with exponents in expanded form (e.g. <math>a^4 = a \cdot a \cdot a \cdot a</math>)</li><li>Use the product property to simplify an expression (e.g. <math>x^4x^2 = (x \cdot x \cdot x \cdot x)(x \cdot x) = x^{4+2} = x^6</math>)</li><li>Use the power raised to a power property to simplify and expression (e.g. <math>(y^3)^2 = (y^3)(y^3) = y^{3 \cdot 2} = y^6</math>)</li></ul>		
<b>Key Vocabulary, Concepts and Symbols:</b> <ul style="list-style-type: none"><li>Understand concepts, symbols, and vocabulary for: expression, exponent, power, base</li></ul>		
<b>Suggested Instructional Strategies:</b> <ul style="list-style-type: none"><li>Model (with manipulatives) each property using repeated multiplication.</li><li>Explicitly teach properties used to simplify expressions with exponents<ul style="list-style-type: none"><li>Multiple exemplars (example/non-example)*</li></ul></li></ul>		
<b>Supports and Scaffolds Considerations:</b> <ul style="list-style-type: none"><li>Templates that model the use of a property.</li><li>Manipulatives that can be used in conjunction with the template.</li><li>Assistive Technology (e.g., interactive whiteboard or other software, calculator , communication device)</li></ul>		
<b>Key Word Search:</b> expression, exponent		